NIF
National Ignition Facility

LIFE: Clean Energy from Nuclear Waste

LIFE, an acronym for Laser Inertial Fusion Engine, is an advanced energy concept under development at Lawrence Livermore National Laboratory (LLNL).

Based on physics and technology developed for the National Ignition Facility (NIF), LIFE has the potential to meet future worldwide energy needs in a safe, sustainable manner without carbon dioxide emissions.

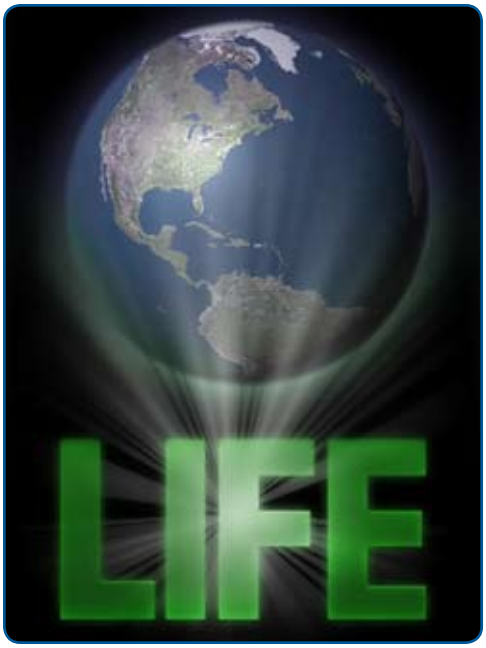
By burning nuclear waste for its fuel, LIFE may have the added benefit of reducing the planet's stockpile of spent nuclear fuel and other nuclear materials that lend themselves to nuclear proliferation.

NIF, a project of the U.S. Department of Energy's National Nuclear Security Administration, is the world's largest and highest-energy laser. NIF is designed to achieve thermonuclear fusion ignition and burn in the laboratory using inertial confinement fusion (ICF). As such, NIF is the culmination of nearly 60 years of research into controlled fusion – capturing the energy of the sun and stars to provide clean, limitless energy on Earth.

Ignition experiments designed to accomplish NIF's goal will begin in 2010, and successful demonstration of ignition and net energy gain on NIF will be a transforming event that is likely to focus the world's attention on the possibility of ICF as a potential long-term energy option.

The Promise of Hybrid Nuclear Power

Success on NIF will serve as a springboard for LIFE, a hybrid technology that combines the best aspects of nuclear fusion, a clean, inherently safe and virtually unlimited energy source, with fission, a carbon-free, reliable energy technology that currently provides about 16 percent of the world's electricity. Through the combination of fusion and fission, LIFE power plants could generate gigawatts of power 24 hours a day for as long as 50 years without refueling while avoiding carbon dioxide emissions, easing nuclear proliferation concerns and mitigating the concerns associated with nuclear safety and long-term nuclear waste disposal.



Existing and future inventories of spent nuclear fuel, natural and depleted uranium and weapons-grade plutonium could produce enough energy to meet the world's energy needs for hundreds to thousands of years. Besides offering energy independence and security, LIFE power plants could provide the United States with an enormous economic competitiveness edge in the energy sector in the coming decade.

The LIFE engine would use an ICF laser system similar to the one now under development at NIF to ignite fusion targets surrounded by a spherical blanket of subcritical fission fuel. The fuel could be one of many fertile or fissile materials, including thorium, light-water reactor spent nuclear fuel, weapons-grade plutonium, highly enriched uranium, and natural and depleted uranium. (Fertile material is nuclear material that can be converted to fissile material through the capture of a neutron, such as uranium-238.)

LIFE: CLEAN ENERGY

LIFE provides a point source of ICF-generated neutrons to extract virtually all of the energy content of its fuel. LIFE would close the nuclear fuel cycle without the need for chemical separation and reprocessing and generate thousands of megawatts of carbon-free electricity. The system would require about half as much laser energy input as a pure fusion plant, and thanks to the extra gain from the fission blanket, produce 100 to 300 times more energy than the input energy. LIFE would be proliferation-resistant and passively safe, require no uranium isotope enrichment and lessen the need for long-term geologic storage of nuclear waste.

LIFE would enable the worldwide expansion of nuclear power in a safe, secure and sustainable manner. A number of reviews and discussions of the proposal with energy experts have been positive and supportive of the concept. A LIFE development team of about 40 physicists, materials scientists, engineers and energy and national security experts from LLNL, the University of California at Berkeley and other institutions is developing a "point design" – the target and laser features for specific experiments – and a path forward for LIFE. ■

A LIFE Engine and Power Plant

LIFE power plants could squeeze the last drop of energy from nuclear waste and other fertile and fissile materials, paving the way to a safe, sustainable, carbon-free energy future. This conceptual design is based on NIF-like fusion targets and a NIF-like laser.